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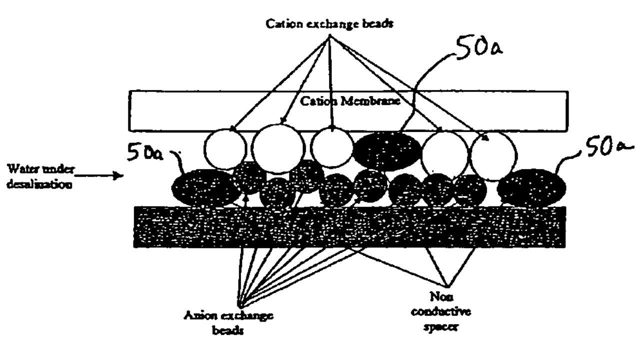
(54) Title: SPARSE MEDIA EDI APPARATUS AND METHOD



Schematic presentation of water splitting and desalination in a bi-layer EDI dilute cell with a spacer of the present invention

(57) Abstract: An electrodeionization, (EDI) apparatus has flow cells with a sparse distribution of ion exchange (IX) material or beads. The beads extend between membranes defining opposed walls of the cell to separate and support the membranes, and form a layer substantially free of bead-to-bead dead-end reverse junctions. The beads enhance capture of ions from surrounding fluid in dilute cells, and do not throw salt when operating current is increased. In concentrating cells, the sparse bead filling provides a stable low impedance bridge to enhanced power utilization in the stack. A monotype sparse filling may be used in concentrate cells, while mixed, layered, striped, graded or other beads may be employed in dilute cells. Ion conduction paths are no more than a few grains long and the lower packing density permits effective fluid flow. A flow cell thickness may be below one millimeter, and the beads may be discretely spaced, form a mixed or patterned monolayer, or form an ordered bilayer, and a mesh having a lattice spacing comparable to or of the same order of magnitude as resin grain size, may provide a distributed open support that assures a stable distribution of the sparse filling, and over time maintains the initial balance of uniform conductivity and good through-flow. The cells or low thickness and this resin layers relax stack size and power supply constraints, while providing treatment efficiencies and process stability. Reduced ion migration distances enhance the ion removal rate without reducing the product flow rate. The sparse resin bed may be layered, graded along the length of the path, striped or otherwise patterned. Inter-grain ion hopping is reduced or eliminated, thus avoiding the occurrence of salt-throwing which occurs at reverse bead junctions of prior art constructions. Conductivity of concentrate cells is increased, permitting more compact device construction, allowing increases in stack cell number, and providing more efficient electrical operation without ion additions. Finally, ion storage within beads is greatly reduces, eliminating the potential for contamination during reversal operation. Various methods of forming sparse beds and assembling the stacks are disclosed.

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